12-006

# FY16 Application for Nursery Research Funding
## Washington State Department of Agriculture - Nursery License Surcharge

**(Please use one application packet, including the Progress Report page for each proposal.**
**You must use our form - *failure to do so may result in not funding your project.*)**

**Project Title: Native Plant Propagation**

**Project Leader: Sarah Hamman**

**Institution (if any): Center for Natural Lands Management**

**Mailing Address: 120 Union Ave SE #215, Olympia, WA 9501**

**Email:** shamman@cnlm.org **Project Phone Number:** (360) 790-4180 **Cell Number:** (____)_____

Note: Project leader or his/her designee must be available at above project phone number on **February 27, 2015** between the hours of 10:00-12:00 and 1:00-3:00.

***(Check One) New Project*** _____ ***Continuing X***_____

**Start Date: July 1, 2015** **Completion Date: June 30, 2016**

**Amount Requested for (FY16) July 1, 2015 to June 30, 2016: $10,000**

If this is a multiple year project, please estimate and list the following information for each future July 1 - June 30 period listed below through project completion:

| Fiscal Years (FY) | July 1, 2016 to June 30, 2017 | July 1, 2017 to June 30, 2018 | July 1, 2018 to June 30, 2019 | July 1, 2019 to June 30, 2020 | July 1, 2020 to June 30, 2021 |
|---|---|---|---|---|---|
| $ Amount Needed | | | | | |

If you are increasing the above amounts since your last application, please explain why:

*Please list **all** other sources and amounts of funding for this project for the current year only: **(Please notify us by February 15 if other funding has been approved and from where.)**

| Source | $ Amount Applied For | Approved | Pending Date of Notification |
|---|---|---|---|
| **Joint Base Lewis-McChord (JBLM)** | **$5,000** | **Yes** | |
| **Volunteer time - CNLM** | **$1,075** | **Yes** | |
| **Unrecovered overhead costs - CNLM** | **$4,237** | **Yes** | |

**Total Amount Needed to Fund Project (include all sources*) $_$20,312**

If total amount from all sources is not granted, will you be able to complete the project? No
Explain: We will not be able to complete the project without joint support from WSDA, JBLM and volunteers to assist with monitoring, data analysis and writing. All of the other sources funding has been approved so we anticipate moving forward on the project.

Please indicate which sector(s) of the nursery industry stand to benefit from the results of your research: (Letters of support from the industry are encouraged.) **Native plant nurseries**: Native plant production nurseries produce and sell plants to public and private entities and individuals with the understanding and expectation that the plants are well-suited for a particular environment and will survive under the conditions there. This may not be true if the plants are grown in the greenhouse without the associated microbial communities that can improve short-term growth and long-term establishment at planting sites. This project will provide information and guidance on how to use mycorrhizal inoculum to enhance growth and establishment.

**Please summarize the purpose of this research: (you may attach additional sheets if necessary or submit this summary in your own format)**

Native plant propagation has emerged as a vital aspect in the conservation of endangered ecosystems in the United States and globally. As directed by Congress, the Bureau of Land Management created the Native Plant Materials Development Program in 2001 to help ensure a stable and economical supply of native plant materials for restoration of disturbed lands. This mandate cites private sector growers as one of the key components in the production process. This effectively provides economic stimulus to the nursery industry if basic agronomic factors have been established for the native species of interest. Despite this subsidy, very little information exists for the propagation and growth of many of our most important restoration species. Propagation methodologies need to be scientifically sound, but also cost effective and easy to replicate for both small and large producers working to propagate native species for restoration of disturbed landscapes.

The south Puget Sound is a region rich in natural resources, yet it hosts one the most threatened ecosystems in the United States. Over 92% of the short grass prairies and oak woodlands of western Washington have been converted to other land uses and only 3% is now considered to be historic prairie. These ecosystems support a wide array of endemic flora with their associated native pollinators, which are now at risk from encroachment by native trees and shrubs and a host of non-native invasive species. Research has shown that effective restoration must involve seeding or planting of native species once non-natives have been removed. As the capacity for land management agencies to work at larger scales has improved, the availability of native plant materials has become the primary limiting factor in the restoration process. Plant production of restoration species has grown exponentially over the last few years to meet regional restoration needs, producing nearly 500,000 plants in 2014. However, clear production techniques have still not been developed for several regionally important native species. This makes it difficult, if not impossible, for private growers to efficiently produce these native plants.

The purpose of this proposal is to support ongoing research of native plant propagation techniques for rare or difficult to grow prairie restoration species. Germination requirements and growth of ten South Puget Sound prairie species were developed in Phases 1-3 by evaluating seed stratification protocols and potential benefits of mycorrhizal inoculation. This FY16 proposal will support evaluation, documentation and communication of the long-term success of these production methods. The complete protocols will be published on the Native Plant Network database for producers to reference and in the peer-reviewed scientific literature for both the scientific and management communities. This project supports both restoration science and provides private growers with key information on species propagation needs.

**Methods of research:**
We will determine the ideal production protocols for our species of interest regarding three important aspects of native plant propagation: 1) Imbibition (pre-sow seed soaking) 2) seed stratification and 3) mycorrhizal inoculation to determine the most effective method of producing quality plugs of native prairie plants for restoration. We would like to expand the mycorrhizal evaluation to include outplanting in the field in FY2015. Many of the benefits of the mycorrhizal association occur during stressful growing conditions not likely to be encountered in a greenhouse setting. While it is possible to simulate these stresses, it is far more relevant to monitor success of the propagules in the field. Therefore, to fully determine whether these treatments are beneficial, we will outplant and monitor field establishment of our treated plants for two years.

Ten species have been chosen for this experiment based upon their importance in prairie restoration, a lack of regional propagation protocols and an availability of seed (Table 1). An effort was made to cover a wide range of plant families. The species tested for Phases 3 and 4 differed slightly from those tested in Phases 1 and 2, based on initial success (or lack of success) of the stratification trials and based on seed availability in for Phases 3 and 4.

Table 1. Species selected for stratification and mycorrhizal inoculation trials

| Species | Common Name | Family |
|---|---|---|
| *Aquilegia formosa*[1,2] | Western Columbine | Ranunculaceae |
| *Balsamorhiza deltoidea*[2] | Deltoid Balsamroot | Asteraceae |
| *Carex inops*[1] | Long-stolon Sedge | Cyperaceae |
| *Castilleja levisecta*[1,2] | Golden Paintbrush | Scrophulariaceae |
| *Dodecatheon hendersonii*[1,2] | Mosquito Bills | Primulaceae |
| *Dodecatheon pulchellum*[1,2] | Darkthroat Shootingstar | Primulaceae |
| *Festuca roemeri*[2] | Roemer's Fescue | Poaceae |
| *Gaillardia aristata*[1,2] | Blanket Flower | Asteraceae |
| *Lithophragma parviflorum*[1] | Small flowered Woodland Star | Saxifragaceae |
| *Micranthes integrefolia*[2] | Whole-leaf Saxifrage | Saxifragaceae |
| *Ranunculus occidentalis*[1,2] | Western Buttercup | Ranunculaceae |
| *Silene douglasii*[1,2] | Douglas' Campion | Caryophyllaceae |
| *Solidago missouriensis*[1] | Missouri Goldenrod | Asteraceae |

[1]Species used for Phases 1 & 2 (imbibition and stratification trials)
[2]Species used for Phases 3 & 4 (mycorrhizal inoculation and outplanting trials)

This experiment will be conducted in FOUR phases, each phase informing the design of the next:

**Phase 1 - Seed Imbibition (complete):** Five replicates of 100 seeds for each species were soaked in room temperature deionized water for 4, 8, 12 and 24 hours. After the prescribed soaking time, seeds were patted dry and weighed. This trial established the imbibition curve for each species and species-specific recommendations for imbibe times (see 2013 Progress Report).

**Phase 2 – Stratification (complete):** The second phase of the project examined the length of stratification time at 3°C that produced the highest percentage of germinating seeds. This was coupled with a smoke water treatment, which determined if any of our target species have a dormancy that is broken by chemical compounds produced during grass fires.

The ideal length of cold stratification was determined for each species by measuring the percent germination after cold stratification treatments of 0, 15, 30, 60, 90 and 120 days. At the end of the stratification period, all seeds were sown following our standard propagation protocols and monitored for six months for germination. The most successful stratification times and treatments were determined (see 2013 Progress Report) and will be incorporated into production protocols.

**Phase 3 – Mycorrhizal inoculation (complete):** The third phase of the experiment utilized the pre-treatments established in Phases 1 and 2, and tested the response of our target species (see revised list of species in Table 1) to inoculation with either native mycorrhizal fungi or commercial mycorrhizal fungi, relative to no mycorrhizae (control).

After imbibing and stratifying seeds according to the most successful methods from Phases 1 and 2, one hundred seeds of each of ten species were sown into plugs containing one of three treatments: 1) native mycorrhizal inoculum (cultivated from the roots of 8 native prairie species in intact South Sound prairie sites), 2) commercially available mycorrhizal inoculum, or 3) no inoculum at all. All treatments were also inoculated with one of three 'soil washes' to introduce microorganisms present in field soils that could interact with mycorrhizal fungi: 1) from high quality (>25 native species) prairie soil, 2) from low quality (<10 native plant species) soils, or 3) from potting soil. All treatments received standard water and low fertilizer applications. The effects on survivability and growth (height, width, above and below-ground biomass) were monitored monthly for six months from germination. Initial findings of treatment effects on survival and growth have been analyzed and summarized in a draft manuscript that will be submitted for publication in *Restoration Ecology* (see attached progress report).

**Phase 4a – Outplanting and Short-term Monitoring (ongoing):** This final phase of the project will determine whether the mycorrhizal protocols developed in Phase 3 lead to elevated field establishment rates of treated plants. This is the ultimate goal of restoration and plant production work; to create resilient, diverse habitats

using healthy greenhouse-grown plants and seeds. Appropriate planting sites were chosen and experimental plots established in pre-treated (burned and herbicided to remove non-native species) areas at 2 prairie sites. Treated plants were strategically outplanted into established plots in November 2014. First year survival will be monitored in June 2015.

**Phase 4b –Monitoring and Communications**: These plants will be monitored for two-year survival and reproductive capacity (# flowers) in June 2016. Treatment effects on initial field survival and reproductive capacity will be reported in the final report, posted on the Native Plant Network's Propagation and Protocol Database (http://www.nativeplantnetwork.org/network/) and findings will be presented at a national conference. Results of field survival and growth will also be prepared and written into a manuscript for submission to a peer-reviewed journal.

**Expenditure Breakdown:**
**(Please include salaries, supplies, travel, etc.)**

FY2016 Funds will be used to support a plant propagator's time (providing guidance and supplies for project, manuscript review), a restoration ecologist's time (conducting data analysis and manuscript writing) technician's time managing this project (monitoring, data management, report and manuscript writing), an Americorps member's time (help with monitoring and data entry) as well as travel and supplies needed for field activities, manuscript publication and one regional or national conference.

**FY 2016:**

| **Budget Item** | **Cost** |
|---|---|
| **Salary** | |
| Plant Propagator | $1520 |
| Restoration Ecologist | $1920 |
| Project Technician | $2400 |
| Americorps Member | $560 |
| **Supplies** | |
| Monitoring supplies | $500 |
| **Travel** | |
| To/from field (442mi @ $0.565/mi) | $250 |
| To conference | $1300 |
| **Outreach** | |
| Conference registration | $400 |
| Publication costs | $1000 |
| **Other** | |
| B&O Taxes | $150 |
| **Total** | **$10,000** |